Understanding cnc machines and pen plotters

CNC MACHINE

the design is loaded into the computer which is attached to the CNC machine. The computer changes the design into a numerical code that controls the way the CNC cuts and shapes the material.

The material to be shaped is taped on to a block with double sided tape. This must be done carefully so that it does not come off the block during machining.

The block is then placed in the vice, inside the CNC. It must be tightened up carefully. If it is not secure when the machine starts to cut the material it can come away from the vice. When the machine starts working, the vice moves up, down, right and left according to the design.

The guard is placed in position. It protects the machine operator in case the material is pulled out of the vice by the power of the cutter. For safety reasons, if the guard is not in position the motor will not start.

The CNC is turned on and the shape is cut from the material. When the cutter has stopped the shaped material can be removed from the vice. Total time - for simple designs - 15 minutes.

CNC means Computer Numerical Control. This means a computer converts the design produced into numbers - co-ordinates. The numbers can be considered to be the coordinates of a graph and they control the movement of the cutter. In this way the computer controls the cutting and shaping of the material.

X, Y and Z axis control the movement of the cutter on a 3D CNC machine. This allows materials to be machined in three dimensions.

Say, point ‘A’ on the plastic block has coordinates 16, 8, 20. The block is composed of thousands of coordinates and the cutter goes from the first set of coordinates to the second set to the third set and so on, until it has completed the thousand coordinates. As the cutter is spinning at high speed, and travels through all the sets of coordinates, it cuts and shapes the block, as it goes along carving the material out.

PEN PLOTTERS

Pen plotters print by moving a pen across the surface of a piece of paper. This means that plotters are vector graphics than raster graphics as with other printers. Pen plotters can draw complex line art, including text, but do so slowly because of the mechanical movement of the pens. They are often incapable of efficiently creating a solid region of color, but can hatch an area by drawing a number of close, regular lines.

Pen plotters have essentially become obsolete, and have been replaced by large-format inkjet printers and LED toner based printers. Such devices may still understand vector languages originally designed for plotter use, because in many uses, they offer a more efficient alternative to raster data.
and offer resolution unlike any other printer. The lines are not made up of dots. They are actually drawn, providing infinite resolution.

**Drum vs flatbed plotters**
Both types of plotters actually "draw" the images. The drum plotter wraps the paper around a drum with pin feeds. It moves the paper back and forth for one direction of the plot. The pens move across the paper, creating the other axis. The bed of the flatbed unit (right) determines the maximum size of the total drawing.

**Drum plotter** - A graphics output device that draws lines with a continuously moving pen on a sheet of paper rolled around a rotating drum that moves the paper in a direction perpendicular to the motion of the pen. Drum plotters move the pen up and down, and the paper left and right by rotating the drum. This enables drum plotters to have a footprint smaller than the final paper size. Plotters can use more than one pen, allowing different colours to be drawn.

**Flatbed plotter** - A graphics output device that draws by moving a pen in both horizontal and vertical directions over a sheet of paper; the overall size of the drawing is limited by the height and width of this bed. Flatbed plotters use a system where the paper is fixed, and the plotter moves a pen up and down, and left and right to draw the required marks on the paper.

**Plotter** - A device that uses one or more pens that can be raised, lowered and moved over the printing media to draw graphics or text.

The heart of the plotter is the printer head assembly, consisting of a horizontal bar and, attached to it, the head assembly holding the pen in use. The pen can be positioned horizontally by moving the pen assembly along the bar. Vertical positioning is achieved by either moving the bar (stationary page plotter) or the paper (rolling page plotter). Combinations of horizontal and vertical movement are used to draw arbitrary lines and curves in a single action, in contrast to printers which usually scan horizontally across the page. Colour plots can be made by using more than one pen.

**Commands**

A number of printer control languages were created to operate pen plotters, and transmit commands like "lift pen from paper", "place pen on paper", or "draw a line from here to here". Early pen plotters, e.g., the Calcomp 565 of 1959, worked by placing the paper over a roller that moved the paper back and forth for X motion, while the pen moved back and forth on a track for Y motion. The paper was supplied in roll form and had perforations along both edges that were engaged by sprockets on the rollers. Another approach, involved attaching ball-point pens to drafting pantographs and driving the machines with motors controlled by the computer. This had the disadvantage of being somewhat slow to move, as well as requiring floor space equal to the size of the paper. A later change was the addition of an electrically controlled clamp to hold the pens, which allowed them to be changed, and thus create multi-colored output. In the 1980s introduced the "grit wheel" mechanism, eliminating the need for perforations along the edges, unlike the Calcomp plotters two decades earlier. The grit wheels at opposite edges of the sheet press against resilient urethane-coated rollers and form tiny indentations in the sheet. As the sheet is moved back and forth, the grit wheels keep the sheet in proper registration due to the grit particles falling into the earlier indentations, much like the teeth of two gears meshing. The pen is mounted on a carriage that moves back and forth in a line between the grit wheels, representing the orthogonal axis.
Heart bot by intel and sms audio generates artwork with cardiac rates

Interpret peoples heart beats and turn them into lines on the wall

-Displaying the audience's participation side by side in one collective piece you see that we each have our own unique physiological response to the environment
-the installation collects heart beat data from people during a fixed time, at a specific location and translates it into generative art.the interactive digital and physical work demonstrates how each individual experiences a unique moment

the ‘heart bot’ analyses peoples' data and generates drawings from them

makes you think how a heart reading can be translated into a specific length – direct that to then the specific type of movements created from chart before – heart beat/pulse snesor and proximity sensor?
David Shingler - Bird Drawing Machine [2008?]

Movement of the stylus is controlled by the chirps of a pair of zebra finches – hard to find information about this project but think its interesting as a concept in relation to my work relationship between the human and the movement/marks of the machine.

The kinetic sculpture is a "Bird Drawing Machine", which consists of a rotating arm on which is mounted a birdcage that contains two tiny birds. As the arm rotates, a stylus shoots out from time to time down and back up parallel to the arm, forming ellipses. The stylus moves into action when the birds chirp, and thus the birds effectively draw the lines (actively when they chirp; passively, when their silence leaves the stylus making circles where it came to rest alongside the rotating arm).
There is a microphone to pick up the bird's chirps.

– There are lots of basic Arduino controlled 3 axis pen plotters on indestructibles.com all dealing with the same principle of the moving plane in one direction and the tool in the other so vertical vs horizontal and there is an interesting potential in this